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# PRELIMINARY VENTILATION SURVEY FOR 9 EAST LONGWALL PRIOR TO IMPLEMENTATION OF MONOLITHIC PACKING

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# PRELIMINARY VENTILATION SURVEY FOR 9 EAST LONGWALL PRIOR TO IMPLIMENTATION OF MONOLITHIC PACKING

by

Andrew W. Stokes*

## ABSTRACT

Consultations between the Cape Breton Development Corporation (CBDC and the Cape Breton Coal Research Laboratory (CBCRL) have identified the problem of leakage of intake air through longwall wastes (gobs) as a major operational problem in the Sydney Coalfield. A joint study of the problem was initiated and is currently in progress. As part of this study, CBCRL are responsible for assessing the performance of any remedial measures which are implemented to reduce the gob leakage.

This report records the results of a ventilation survey performed around 9 East longwall in Lingan Colliery a few weeks prior to a change in the intake gateroad packing system from conventional stone filled hardwood packs to monolithic packing. A brief discussion relates the similarity of the leakage characteristics to those recorded on the adjacent longwall and the apparent effects of the gateroad sealant currently being sprayed in the intake level.

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# ÉTUDE PRÉLIMINAIRE DU CIRCUIT DE VENTILATION DU FRONT DE TAILLE N° 9 EST AVANT L'AMÉNAGEMENT D'UN REMBLAI MONOLITHIQUE

par

Andrew W. Stokes

Des consultations entre la Société de développement du Cap-Breton (SDCB) et le Laboratoire de recherche sur le charbon du Cap-Breton (LRCCB) ont permis d'identifier les fuites d'air dans les résidus des tailles à long front aligné (vieux travaux), comme étant un problème opérationnel majeur à la houillère de Sydney. Une étude conjointe visant à résoudre le problème est actuellement en cours. Dans le cadre de cette étude, le LRCCB est chargé d'évaluer la valeur de toute mesure corrective qui sera prise pour réduire les fuites d'air dans les vieux travaux.

Le présent rapport porte sur les résultats de l'étude du circuit de ventilation effectuée au front de taille N° 9 Est à la houillère Lingan quelques semaines avant que l'on ne change le système d'entrée d'air du remblai de la voie de roulage, d'un système classique de bois dur rempli de roches à un système de remblai monolithique. Le rapport présente un bref examen des ressemblances entre les caractéristiques des fuites d'air observées au front de taille N° 9 et celles qui se sont produites au front de taille avoisinant ainsi que des effets apparents de l'agent d'étanchéité de la voie de roulage qui est actuellement vaporisé au niveau de l'entrée d'air.

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## INTRODUCTION

A previous report by Cain et. al. (1) has highlighted the problems of gob leakage in the Sydney Coalfield and the methods which are, and have been, used to control it. The most successful method to date is the reduction in the differential pressure across the gob by the utilisation of a connection to an adjacent worked out longwall panel (termed cundy ventilation).

The current production schedule at Lingan Colliery requires full production of coal from two adjacent longwall faces, 8 East and 9 East, simultaneously. This effectively rules out the use of cundy ventilation for 9 East. Without remedial measures to reduce the gob leakage on 9 East the problem would become intolerable before the end of the wall's working life. This has caused a re-evaluation of the other solutions to the gob leakage problem.

As of mid February, 1985, 9 East longwall had advanced some 550 m from the face start line and the gob leakage was already severe. The end of February, 1985, was chosen as the start date of a new intake gateroad packing system (monolithic packing) intended to improve the pack density and hence reduce the gob leakage. CBCRL is committed to assessing the performance of the monolithic packing to determine its effect on the roadway support and also on its ability to reduce the gob leakage. As part of this program other longwalls in Lingan Colliery have been surveyed to determine air leakage characteristics (2,3) and roadway support characteristics (4). These measurements will form the base data with which the results of future surveys of 9 East will be compared. To provide additional data prior to the use of the monolithic packing on 9 East, a full ventilation survey was conducted. This report presents the findings of this survey and briefly compares them with the results from other longwall ventilation surveys at Lingan.

## VENTILATION MEASUREMENTS

The methodology used in the ventilation surveys of advancing longwalls is described in more detail elsewhere (2,3). Briefly, the airflows are measured at regular intervals along both gateroads (25 m - 50 m) using conventional anemometry techniques and also with tracer gas. These results are then used together with the results of an accurate pressure survey to calculate an approximate value for the resistance to the passage of air

afforded by the gateroad packs and the gob area between the two gateroads.

The repeat determination of these resistance values after the implementation of remedial measures allows a "before and after" comparison, which in turn is a measurement of the new system's effectiveness.

## SURVEY RESULTS AND DISCUSSION

Figure 1 and 2 show a graphical representation of the results from tables 1, 2, and 3 of a ventilation survey conducted on 9 East on Saturday, February 9, 1985.

Figure 1 is the pressure profile measured around the district and is comparable with those previously measured around 8 East and 4 West longwalls. Figure 2 shows the airflows measured in the gateroads plotted against the inbye distance of the measuring points from the face start line. The crosses are the anemometry measurements made in the intake and the circles those recorded in the return. These values show too large a deviation from any trend whilst the third set of readings made in the return gateroad using tracer gas allows a much more accurate return airflow profile to be plotted. The deviation of individual readings from this line is very small (±3%) giving a high degree of confidence in the results. For this reason the tracer gas determined airflows have been used in the gob resistance calculations.

Of the 30.5 $m^3/s$ of air entering 9 East through the fireseal only 16.5 $m^3/s$ was measured in the return gateroad 25 m back from the face. This represents a ventilation efficiency of 54 percent or a leakage of 46 percent of the air through the gob.

The resistance of the gateroads is approximately 0.036 $Ns^2/m^8$ per 100 m for the intake and 0.042 $Ns^2/m^8$ per 100 m for the return. These values are in line with other published results (5) and consistent with values measured in 8 East and 4 West.

Figure 3 is a plot of the ventilation efficiency of 8 East longwall versus the face advance. This graph was generated through predictions made with a ventilation network analysis program using the results of another survey. Marked on the graph are the lines indicating the ventilation efficiency expected after 550 m of face advance. These show a predicted efficiency of 49 percent which corresponds closely with the measured value of 54 percent measured for 9 East.

The discrepancy between the two values may be explained by the attempts which have been made to reduce the leakage from 9 East's intake gateroad by spraying a proprietary sealant (namely shotcrete) onto the gob side pack. At the time of the survey approximately 200 m of the gobside pack from the face startline inbye had been sprayed with a thin layer of shotcrete.

Calculations of the resistance of the gob corridors were performed. These give values of between 45 and 65 $Ns^2/m^8$. These values are characteristic of a low resistance area of gob and agree closely with the calculated resistances of the first 400 m of gob closest to the face start line of 8 East. This supports the theory that geological conditions on the eastern side of the deeps of Lingan are responsible for the higher air leakages experienced there. Gob resistances calculated for 4 West were in general an order of magnitude higher than for 8 and 9 East. These low resistance values tend to correspond with the close proximity of massive sandstone structures in the roof strata which may be affecting the collapse, break up and recompaction of the roof strata in the gob.

## AIRFLOW MEASUREMENTS

It is recognized that there can be a wide variation in the airflows measured in and around the longwall districts using the different techniques available.

The three methods commonly used at present are:

1. Using an anemometer without an extension handle.
2. Using an anemometer with an extension handle.
3. Using the dilution of a steady stream of tracer gas.

Of the above three methods, tracer gas offers the highest potential for accuracy and this is shown by the survey results. Next is the anemometer traverse performed with anemometer attached to an extension handle; allowing all parts of the roadway cross section to be reached. The most inaccurate method is using an anemometer without an extension handle (6). Inevitably, the operator is forced to stand close to the anemometer during its traverse which causes the airstream moving through the vanes to be disproportionally high. In addition, large roadways are too high to allow the operator to reach the low flow areas in the crown of the profile. Consequently, flows

measured using this method are generally recorded as being significantly larger than they actually are.

By way of example, the same airflows have been measured by CBDC staff using an anemometer without an extension handle and by CBCRL staff using tracer gas. Discrepencies are always similar in magnitude with CBDC readings being 20-30% higher than those measured with the tracer gas. This may indicate that a review of the airflow measurement methodology is required.

## CONCLUSIONS

The air leakages measured in 9 East longwall on February 9, 1985, prior to the use of monolithic packing are similar to those predicted from the results of surveys on 8 East.

The use of shotcrete to prevent leakage from the intake gateroad may eventually effect a reduction, but so far the measurable effect of the first 200 m is small to negligible.

The predicted gob leakages for 9 East are very similar to those for 8 East and without successful remedial measures will be intolerable before the end of 9 East's planned working life.

## REFERENCES

1. Cain, P., Stokes, A. and Genter, D. "Preliminary report on studies into gob leakage in the Sydney Coalfield"; CANMET, CRL, Divisional Report ERP/CRL 84-43(OP); December 1984; pp. 18.
2. Stokes, A. "Gob leakage investigations in 4 West advancing longwall"; CANMET, CRL, Divisional Report (in preparation); February 1984.
3. Stokes, A. "Gob leakage in 8 East advancing longwall"; CANMET, CRL, Divisonal Report (in preparation).
4. Cain, P. and Aston, T. "Strata control investigations in the Sydney Coalfield"; CANMET, CRL, Divisional Report; December 1982.
5. National Coal Board. "Colliery officers ventilation handbook".
6. Hartman, H.L. "Mine ventilation and air conditioning"; New York, Interscience; 1982.

Table 1 - Pressure survey results

| | | | |
|---|---|---|---|
| A | AA | 1.5" | ACROSS DOORS |
| A | B | 0.035 | |
| | | 0.03 | |
| | | 0.035 | |
| (Regulator doors) | | 0.1 | |
| | $\Sigma$ | 0.20" | |
| B | BB | 0.05 | |
| | | 0.05 | |
| | | 0.095 | |
| | | 0.040 | |
| | | 0.045 | |
| | | 0.040 | INTAKE |
| | | 0.040 | |
| | | 0.040 | GATEROAD |
| | | 0.040 | |
| | | 0.020 | |
| | | 0.020 | |
| | | 0.035 | |
| | | 0.005 | |
| | $\Sigma$ | 0.520" | |
| BB | AA | 0.025 | |
| | | 0.020 | |
| | | 0.025 | FACE |
| | | 0.030 | |
| | | 0.040 | |
| | $\Sigma$ | 0.140" | |

Table 1 - Continued

| | | | |
|---|---|---|---|
| AAA | AA | 0.030 | |
| | | 0.035 | |
| | | 0.060 | |
| | | 0.035 | |
| | | 0.055 | |
| | | 0.045 | RETURN |
| | | 0.055 | |
| | | 0.075 | GATEROAD |
| | | 0.045 | |
| | | 0.100 | |
| | | 0.070 | |
| | | 0.080 | |
| | | 0.685" | |

$$A_{AA} = \sum [(AA - AAA) + (AAA - BB) + (BB - B) + (B - A)]$$

$$A_{AA} = 0.2 + 0.52 + 0.14 + 0.685 = 1.545$$

$$\% \text{ Error} = \frac{(1.545 - 1.5)}{1.5} \times 100\% = 3\% \text{ error}$$

Table 2 - Anemometry results

| | INTAKE GATEROAD | | | RETURN GATEROAD | | |
|---|---|---|---|---|---|---|
| Inbye Distances (m) | Average Velocity Readings (m/min) | Area ($m^2$) | Q. ($m^3/s$) | Average Velocity Readings (m/min) | Area ($m^2$) | Q. ($m^3/s$) |
| 0 | 300 | 7.21 | 36.76 | 244 | 7.65 | 30.87 |
| 50 | 219 | 8.05 | 28.28 | 278 | 7.31 | 33.87 |
| 100 | 200 | 8.54 | 28.60 | 238 | 7.01 | 28.05 |
| 150 | 205 | 8.37 | 28.59 | 240 | 6.65 | 26.50 |
| 200 | 185 | 8.82 | 27.48 | 220 | 7.28 | 26.68 |
| 250 | 169 | 8.42 | 23.72 | 198 | 7.08 | 23.25 |
| 300 | 157 | 7.49 | 19.6 | 184 | 7.25 | 22.24 |
| 350 | 163 | 7.24 | 19.68 | 230 | 5.61 | 21.50 |
| 400 | 128 | 9.07 | 19.34 | 212 | 6.89 | 24.36 |
| 450 | 118 | 9.70 | 18.92 | 171 | 7.16 | 20.53 |
| 500 | 70 | - | - | 108 | 8.42 | 15.15 |

Table 3 - G.C. analysis of gas bag samples

| Sample Number | Location | Time Taken | Peak Height | Concentration PPB | Indicated Airflow ($m^3/s$) |
|---|---|---|---|---|---|
| C1 | Control Point (75 m from face) | 0910 | 74.0 | 59.0 | 17.0 |
| C2 | Control Point (75 m from face) | 0915 | 73.2 | 58.4 | 17.2 |
| C3 | Control Point (75 m from face) | 0920 | 75.7 | 60.4 | 16.6 |
| C4 | Control Point (75 m from face) | 0925 | 74.0 | 59.0 | 17.0 |
| C5 | Control Point (75 m from face) | 0930 | 73.2 | 58.4 | 17.2 |
| C6 | Control Point (75 m from face) | 0935 | 72.2 | 57.6 | 17.4 |
| C7 | Control Point (75 m from face) | 0940 | 73.5 | 58.6 | 17.1 |
| C8 | Control Point (75 m from face) | 0945 | 73.1 | 58.3 | 17.2 |
| C9 | Control Point (75 m from face) | 0950 | 72.8 | 58.1 | 17.3 |
| C10 | Control Point (75 m from face) | 0955 | 73.7 | 58.8 | 17.1 |
| 1 | Station #1 | 0957 | 48.8 | - L e a k y B a g - | |
| 2 | Station #2 | 0906 | 71.4 | 57.0 | 17.6 |
| 3 | Station #3 | 0955 | 75.2 | 60.0 | 16.7 |
| 4 | Station #4 | 0909 | 70.2 | 56.0 | 17.9 |
| 5 | Station #5 | 0950 | 69.6 | 55.5 | 18.1 |
| 6 | Station #6 | 0911 | 66.8 | 53.3 | 18.8 |
| 7 | Station #7 | 0948 | 63.0 | 50.3 | 19.9 |
| 8 | Station #8 | 0915 | 63.6 | 50.7 | 19.8 |

Table 3 - Continued

| Sample Number | Location | Time Taken | Peak Height | Concentration PPB | Indicated Airflow ($m^3/s$) |
|---|---|---|---|---|---|
| 9 | Station #9 | 0945 | 60.7 | 48.4 | 20.7 |
| 10 | Station #10 | 0917 | 56.8 | 45.3 | 22.1 |
| 11 | Station #11 | 0942 | 56.0 | 44.7 | 22.4 |
| 12 | Station #12 | 0919 | 53.6 | 42.8 | 23.4 |
| 13 | Station #13 | 0940 | 51.3 | 40.9 | 24.5 |
| 14 | Station #14 | 0921 | - | L e a k y B a g | - |
| 15 | Station #15 | 0939 | 51.0 | 40.7 | 24.7 |
| 16 | Station #16 | 0923 | - | L e a k y B a g | - |
| 17 | Station #17 | 0937 | 46.2 | 36.9 | 27.2 |
| 18 | Station #18 | 0925 | 53.8 | 42.9 | 23.4 |
| 19 | Station #19 | 0935 | 42.8 | 34.1 | 29.4 |
| 20 | Station #20 | 0928 | - | L e a k y B a g | - |
| 21 | Station #21 | 0933 | 41.3 | 32.9 | 30.5 |
| 22 | Between fire seal and FSL | 0930 | - | L e a k y B a g | - |

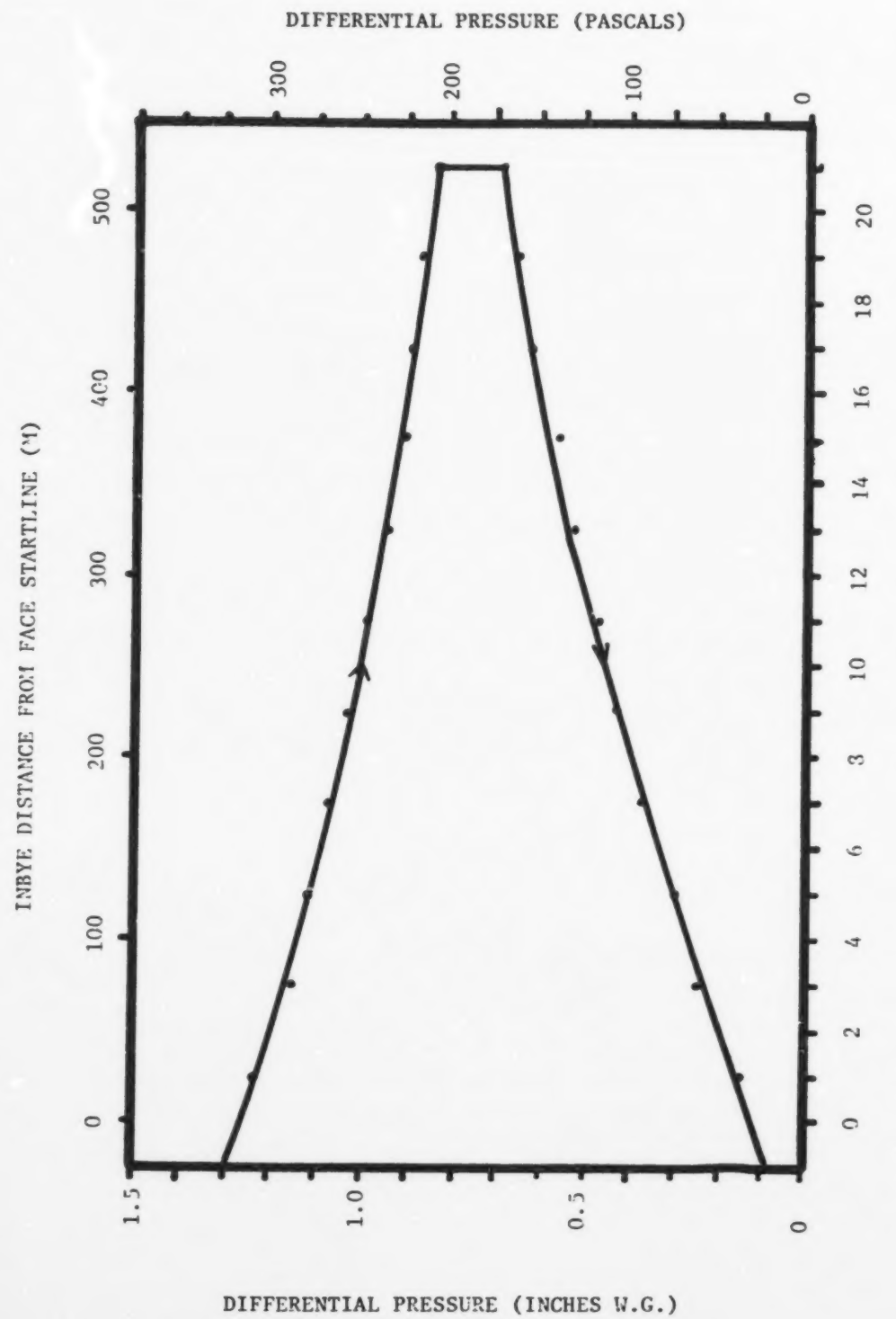


Figure 1 - 9 East district differential pressure profile

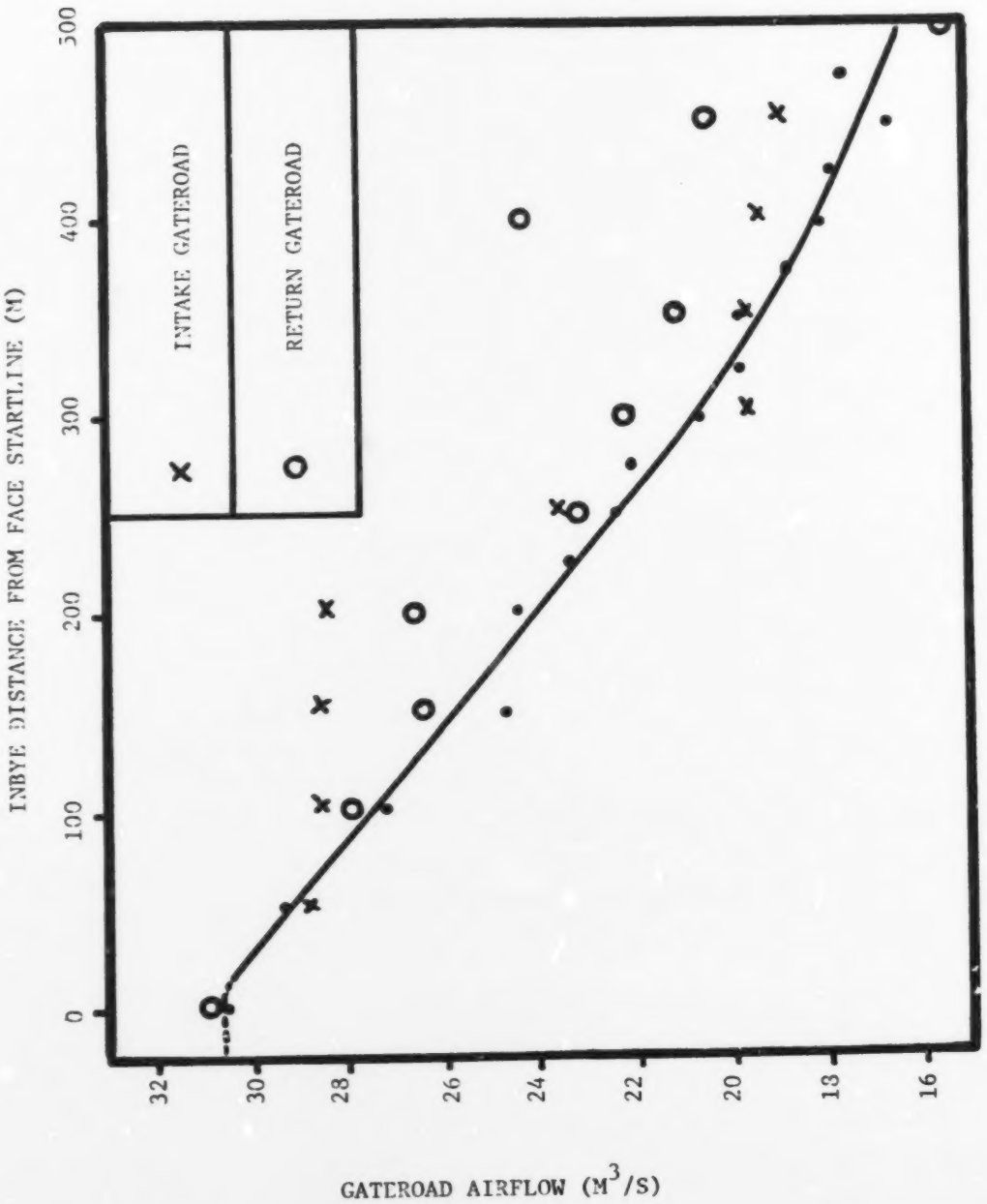


Figure 2 - 9 East gateroad airflow profile

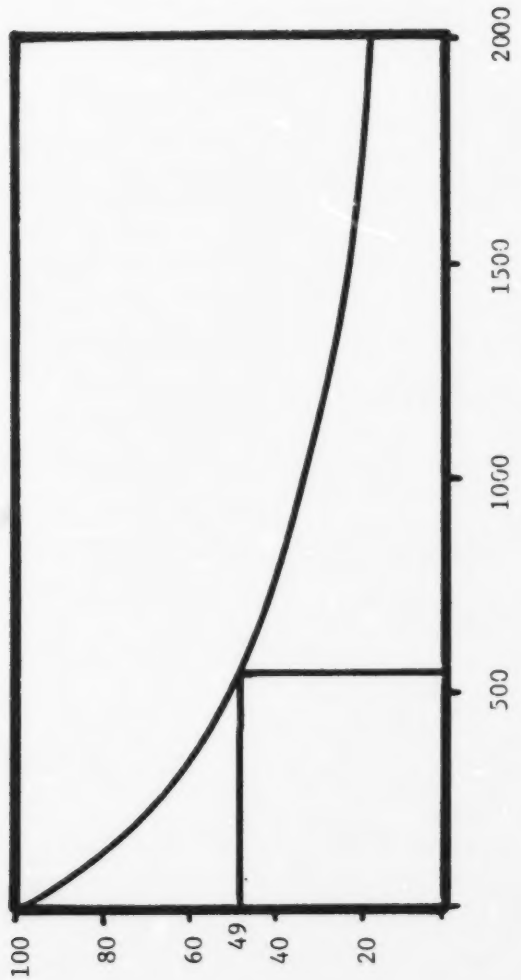


Figure 3 - Prediction of ventilation efficiency in 8 East district over 2000 m of panel advance